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DEEPWATER News
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A Network-Centric Enabler for Deepwater

The Deepwater Program's recapitalization of the Coast Guard's aging fleet of cutters, aircraft, and supporting systems is being cultivated as part of a "system of systems" approach. Graphic by Integrated Coast Guard Systems

The Integrated Deepwater System's recapitalization of the Coast Guard's aging inventory of cutters, aircraft, and supporting systems is remarkable in many respects, but its overarching construct as a system of systems promises to improve the effectiveness of Coast Guard operations at an affordable cost in ways that are not fully appreciated today.

"When Deepwater is complete," said Coast Guard Commandant Adm. Thomas H. Collins earlier this year, "our cutters and aircraft will no longer operate as independent platforms with only limited awareness of what surrounds them in the maritime domain.

"Instead, they will have the benefit of receiving information from a wide array of mission-capable platforms and sensors—enabling them to share a common operating picture as part of a network-centric force operating in tandem with other cutters, boats, and both manned aircraft and unmanned aerial vehicles."

The Deepwater system of systems is a collection of different elements that together produce results not obtainable by the individual elements alone.

These include platform systems (aircraft, cutters, and patrol boats), subsystems (radars, radios, satellite communications, etc.), as well as individual components and assets (people, hardware, software, shore facilities).

All elements combine to generate capabilities needed to produce system-wide results. The value added by the system as a whole, beyond that contributed independently by its individual elements, is created by the integration among the elements (i.e., how they are interconnected and combined in order to work together).

Systems engineering is the foundation for the design, development, and deployment of the Deepwater system of systems. It is a Coast Guard-industry team effort, with the Coast Guard first defining operational environments and system-wide performance objectives.

It then falls to Deepwater's partner in industry and systems integrator, Integrated Coast Guard Systems (ICGS, a joint venture between Lockheed Martin and Northrop Grumman), to apply a systems-engineering approach to meet those objectives.

The result will be a transformation of today's Coast Guard to a 21st-century force employing more capable platforms, sensors, and systems—a force able to sustain operational readiness at needed levels and to implement the Coast Guard's maritime strategy and acquire maritime domain awareness more effectively at an affordable cost.

The critical component of systems engineering is operational analysis of the effectiveness of varied force structures, tactics, procedures, techniques, and combinations of C4ISR (command, control, communications, computers, intelligence, surveillance, and reconnaissance) systems. Modeling and simulation tools allow ICGS systems engineers to determine the op-

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Putting People at the Center of the System of Systems

With the progression of the Deepwater program, the U.S. Coast Guard has set in motion a significant organizational restructuring effort that is driving many cultural, practical, and technical changes.

Alongside industry partner Integrated Coast Guard Systems (ICGS), the Coast Guard has initiated a collaborative effort with systems engineering, ship building, logistics, and program management professionals from Northrop Grumman and Lockheed Martin.

"One of our top priorities, in addition to our operational goals, is to ensure that the needs of the crew are being met.," said Cdr. Robert Crane, Deepwater Personnel Lead.

"Affecting everything from the number of racks in each stateroom to bridge configuration, the Deepwater team is identifying programmatic and personnel changes necessary to ensure that the best mix of people with the right skills are assigned to each asset."

Though the total period encompassing the Deepwater Program's implementation will exceed the tenure of many currently serving today, the legacy fleet is already beginning to experience the benefits of the undertaking.

In order to meet maritime threats and challenges of tomorrow, the Deepwater Program is taking an integrated approach to upgrading existing assets while transitioning to newer, more capable platforms with improved systems for command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) and innovative logistics support.

The Deepwater Program has initiated the upgrade of communications equipment that will allow the 210, 270, and 378 foot cutter classes as well as future Deepwater assets to connect to networks for sharing information while underway. Maintaining uninterrupted access to this wealth of information will assist the Coast Guard in maintaining maritime domain awareness while executing its homeland security missions.

The needs of the user are a priority under the Deepwater Program's system of systems construct. United States Coast Guard Photo

The conversion of the 110 to 123 foot Island Class patrol boats presented the opportunity to organize a user centered design review of the bridge where ICGS systems engineers and the crew of the CGC Matagorda worked together to improve the layout for the control console and navigation table. Changes made to the bridge layout were heavily influenced by understanding how the systems and equipment would be used by the operators in the performance of their jobs.

Committed to delivering the men and women in the field tools designed to meet human performance criteria, Deepwater assets will promote more consistent performance in task execution with fewer 'workarounds'.

Historically acquisition programs have not allowed human performance criteria to influence system design.

A more modern process is driving Deepwater acquisitions, the total systems engineering process focused on identifying the roles and requirements of the users, operators, and support staff in order to define concepts of operations that will influence design.

The approach has provided a more rigorous process to assess workload at the deck plate level. Following the lead of the Defense Department, the Coast Guard has expanded the definition of a "system" to include hardware, software, and people.

This mindset enables the Deepwater Program to place the needs of the user at the center of design, directing engineering and acquisition efforts to recognize the safety and interactions of people with the software and hardware elements used to perform their missions.

There are two load bearing support structures in the total systems engineering process that are used to deliver the traceable accurate data necessary for program managers to make more informed allocation decisions.

The first is Human Systems Integration (HSI) which seeks to increase operational effectiveness (OpEff) by optimizing the performance, comfort, and safety of the *continued on page 3*

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operators, support and maintenance personnel. The second is Top Down Requirements Analysis (TDRA) used to identify the skills necessary to optimize system performance. HSI is a systems engineering discipline, while TDRA is the systems engineering application through which HSI is able to provide engineers with the analyzed requirements, workload estimates, task models, system metrics and manning models necessary to understand how the collaborative roles of hardware, software and people may change in response to workload, crew availability, and changes to mission needs.

"Change is necessary and good," noted Crane, "Deepwater provides the Coast Guard an excellent opportunity to make the service operationally and logistically more efficient."

Discussion of alternative crewing concepts involves change much greater than the number of days at sea or the size of the crew assigned to newer assets.

The service is developing a better understanding of the skills required to effectively operate and maintain the Deepwater system-of-systems.

In seeking to leverage technology to optimize ship manning and workload, rigorous analysis is required to define the complete range of human requirements.

"More informed decisions are necessary today so that Deepwater assets are optimally manned tomorrow," said Crane. "Our hope is to show that we are as committed to the people of the Coast Guard as they are committed to the nation they serve."

by Simon P. Castellucio

Deepwater Staff Supports ASNE Day 2004

Representatives from the Integrated Deepwater System's (IDS) Program Office were on hand this Summer to participate in the annual "ASNE Day" symposium in Arlington, Va., sponsored by the American Society of Naval Engineers.

Presentations on Deepwater's system-of-systems approach for the recapitalization of the Coast Guard dovetailed nicely with ASNE's theme for its 2004 gathering: Naval Engineering—Transforming Maritime Defense and Sea Power."

Deepwater's Deputy Program Executive Officer, Gregory Giddens, was paired as a keynote speaker with the Navy's Rear Adm. Charles S. Hamilton II, Program Executive Officer for Ships, to open ASNE's proceedings on the morning of June 28.

He discussed the status of current Coast Guard capabilities and missions, Deepwater's network-centric systems solution for the implementation of the Department of Homeland Security's strategic plan, IDS surface and air assets, maritime domain awareness, and the Coast Guard's ongoing cooperation with Navy acquisition programs in support of the National Fleet policy.

Rear Adm. Erroll Brown, Assistant Commandant for Systems at Coast Guard Headquarters, presented Lt. James A. Novotny with ASNE's "Claud A. Jones Award" for his outstanding contributions to the Coast Guard naval engineering program while serving as the cutter support branch chief at Maintenance and Logistics Command, Pacific.

Novotny, only the second Coast Guard officer to receive ASNE's prestigious engineering award, was the first junior officer so recognized. Novotny was honored for his singular achievement in delivering and supporting Coast Guard patrol boats to the Persian Gulf in support of Operation Iraqi Freedom over the past year.

Two Deepwater technical papers were presented by IDS representatives during ASNE's afternoon sessions. Cdr. Michael Anderson, IDS C4ISR Project Manager, discussed Deepwater's network-centric approach to maritime domain awareness, and Gordon Peterson presented a paper co-authored with Lt. Cdr. Troy Beshears on the HV-911 Eagle Eye tiltrotor vertical takeoff-and-landing unmanned aerial vehicle.

Of Note…

Business intelligence firm SAS has been awarded a contract to create a performance management system to support the Deepwater Program.

Using SAS® Strategic Performance Management software, the Deepwater Program will implement a Web-based performance management evaluation system to gather, analyze, report and share program performance information across multiple channels.

The performance management system will be used by personnel at all levels of the Deepwater Program to assist in performance-based budget support, balanced scorecard measures, and award term and award-fee measures.

The system is expected to be complete within six months.

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timum force configuration to meet the Coast Guard's performance goals, operational requirements, and cost constraints. Extensive studies examined all Coast Guard mission areas—including maritime security, safety and mobility, national defense, and protection of natural resources.

These studies produced today's planned Deepwater system of systems of platforms, C4ISR, and integrated logistics—a system tailored to the Coast Guard's five principal regions (Northeast, Southeast, Western, Alaska, and international).

This complex analysis takes into account detailed operational modeling of platforms and systems, optimized force mixes of varying size, asset applications using various concepts of operation, and timed incremental implementations across the life of the program.

ICGS also adheres to a structured, systems engineering approach whenever it evaluates alternative system designs and conducts studies to identify optimum solutions balancing total ownership cost (for procurement, integration, operations, maintenance, technology refreshment, and personnel), operational effectiveness (system performance for threat negation, incidence prevention or reduction, and interoperability), and sustainability (training, maintenance, logistics, procedures, obsolescence).

It is a multifaceted process. System engineering evaluations are performed across the system, subsystem, and component levels to analyze products and capabilities for both interoperability and system synergy to allow Deepwater's engineers to predict total system performance for numerous configurations (e.g., types and capabilities of assets, numbers of platforms, C4ISR architecture, etc.) and scenarios. The ICGS team also applies an orderly systematic analysis to C4ISR development and integration that is open to various solutions in a "best-of-breed" approach.

Numerous modeling and simulation tools are integrated to allow comparison of the overall performance of the Deepwater system of systems to that of today's legacy force.

The integration of various Coast Guard legacy platforms and systems presents a highly complex challenge in system design. Initial Deepwater implementation, as well as subsequent upgrades and enhancements, must be addressed even as current operations continue at a high tempo and new missions evolve.

Team Deepwater's approach to systems engineering ensures that the Deepwater system – of systems model retains the flexibility to be adapted to changing circumstances—like the accelerated modernization of legacy platforms experiencing unacceptably high system failures—or changes in requirements.

For example, the Coast Guard recently completed its post-9/11 *Performance Gap Analysis* and will recommend to the Department of Homeland Security that a revised Deepwater Mission Needs Statement be approved with corresponding changes to IDS requirements. If approved, today's planned Deepwater Program will be revised to accommodate these new requirements.

Because of this need to remain flexible and responsive over the life of the program, the Deepwater system engineering strategy relies on spiral development to respond to evolving technology or changes in mission requirements.

Spiral development accommodates a need to establish requirements in an iterative process, by partitioning capabilities that can be defined, developed, refined, and matured without causing rippling dependencies among other capabilities.

The spiral process encourages in-stream improvement and refinement that allows system developers to upgrade capabilities incrementally until the system fully meets customer expectations. Each spiral can accommodate successive iterations of requirements development and solutions testing, starting from broad aspects and progressing (i.e., spiraling) toward more specific aspects.

Customer feedback from Coast Guard operators—in the form of cutter patrol summaries, Area Commander assessments, and technical-performance measures—will be used to assess system performance as it evolves. For Deepwater, reevaluation is an essential part of the spiral-development process so that changing needs, missions, and new technology can be incorporated into the system of systems over the life of the program.

Unlike many major acquisition efforts, the Coast Guard has designed and is implementing a program that will result in unprecedented levels of capability at costs lower than could be achieved using a "one-asset-at-a-time" recapitalization approach.

In today's complex and interconnected world, sound systems engineering is the pathway to enable the Deepwater network-centric, system-of-systems to serve as a model for other major acquisition programs for many years to come.

By Mark Gaspar. Mr. Gaspar is Dir. of Business Development, Washington Operations, for Lockheed Martin.